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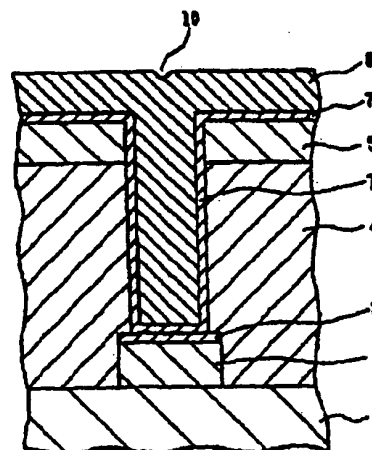
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(54) **Method and apparatus for plating and plating structure**

(57) There is a method and apparatus for plating in which electroless copper plating is performed in a contact hole and an interconnect trench on a minute scale of a semiconductor integrated circuit device, and a plating structure. Organic material originated from an organic gas carried over from the preceding step is removed from the inner surface of a blind hole, thereafter the surface of the barrier layer (7) is subjected to predetermined pretreatments comprising a hydroxylation treatment, a coupling treatment, a Pd colloidal solution treatment and the like, and following the pretreatments, electroless plating (8) with copper is effected desirably under influence of ultrasonic waves. Hence, a uniform, good quality plating layer (8) is formed inside and outside the hole and a CMP processing following the plating is performed with ease.

FIG. 8



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which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

EP 00 40 0172

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL7)
X	EP 0 506 993 A (GEO CENTERS INC) 7 October 1992 (1992-10-07)	1,3,14,33	H01L21/288 C23C18/16
Y	* column 8, line 5 - line 25 *	2,6,34,35	H01L21/768 H01L21/306
	* column 9, line 27 - column 14, line 25 *		
	* column 17, line 15 - column 18, line 5 *		
	* column 26, line 5 - line 21 *		
	* column 30, line 39 - column 32, line 38; figure 3AB *		
A		16,38	
X	US 5 696 207 A (CALVERT JEFFREY M ET AL) 9 December 1997 (1997-12-09)	33	
Y	* column 4, line 31 - column 7, line 1 *	1,14	
A	* column 10, line 31 - line 58 *	2,3,34,35	
X	WO 97 46326 A (UNIV TOLEDO) 11 December 1997 (1997-12-11)	33	
A	* page 1, line 28 - page 9, line 6 *	1,2,34	TECHNICAL FIELDS SEARCHED (InCL7)
A	* page 7, line 1 - page 9, line 6; table 1 *	2,4	H01L C23C
	-/-		
INCOMPLETE SEARCH			
<p>The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.</p> <p>Claims searched completely:</p> <p>Claims searched incompletely:</p> <p>Claims not searched:</p> <p>Reason for the limitation of the search:</p> <p>see sheet C</p>			
Place of search		Date of completion of the search	Examiner
THE HAGUE		19 September 2000	Micke, K
CATEGORY OF CITED DOCUMENTS			
<p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>			
<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p>			
<p>& : member of the same patent family, corresponding document</p>			



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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	WO 97 22733 A (FSI INT) 26 June 1997 (1997-06-26) * page 4, line 8 - page 5, line 2 * * page 7, line 3 - page 11, line 14 * * page 13, line 11 - line 13 * * page 13, line 25 - page 14, line 2; figures 1,2 *	17,29,30	
A	* page 5, line 24 - page 6, line 22 *	2,4	
X	WO 84 01392 A (ECONOMICS LAB) 12 April 1984 (1984-04-12) * page 4, paragraph 2 * * page 8, paragraph 5 - page 10, paragraph 2 * * page 11, paragraph 3 - page 13, paragraph 2; figure 1 *	17,29,30	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
Y	WO 97 22419 A (ENTHONE OMI INC) 26 June 1997 (1997-06-26) * page 5, line 25 - page 6, line 29 *	2,34,35	
Y	US 3 011 920 A (SHIPLEY COMPANY) 5 December 1961 (1961-12-05) * column 2, line 22 - line 65; example 1 * * column 5, line 27 - line 45 *	1,14	
A		2	
Y	PATENT ABSTRACTS OF JAPAN vol. 008, no. 029 (E-226), 7 February 1984 (1984-02-07) -& JP 58 190025 A (TOKYO SHIBAURA DENKI KK), 5 November 1983 (1983-11-05) * abstract *	6	



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Office

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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 283 (C-0955), 24 June 1992 (1992-06-24) - & JP 04 074870 A (EBARA YUJIRAITO KK), 10 March 1992 (1992-03-10) * abstract *	2,4	
A	US 5 674 787 A (ZHAO BIN ET AL) 7 October 1997 (1997-10-07) * column 7, line 35 - line 56 *	2,4	
A	PATENT ABSTRACTS OF JAPAN vol. 012, no. 181 (C-499), 27 May 1988 (1988-05-27) - & JP 62 287081 A (SEIKO EPSON CORP), 12 December 1987 (1987-12-12) * abstract *	2,4,5	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	LEE C -Y ET AL: "DIFFUSION BARRIER PROPERTIES OF ELECTROLESS NI FOR ELECTROLESS CU USING CU PLATING EMPLOYING HYPOPHOSPHITE AS A REDUCING AGENT" JOURNAL OF MATERIALS SCIENCE. MATERIALS IN ELECTRONICS, GB, CHAPMAN AND HALL, LONDON, vol. 9, no. 5, October 1998 (1998-10), pages 337-346, XP000824176 ISSN: 0957-4522 * page 338, left-hand column, paragraph 2 *	2,4,5	
A	US 4 169 171 A (NARCUS HAROLD) 25 September 1979 (1979-09-25) * column 5, line 24 - line 25; example 1 * * column 7, line 47 - line 52 *	2,4	
A	US 5 837 662 A (DOANE THOMAS EUGENE ET AL) 17 November 1998 (1998-11-17) * column 2, line 6 - column 3, line 13 *	2,7,8	
	-/--		



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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	US 5 178 682 A (TSUKAMOTO KATSUHIRO ET AL) 12 January 1993 (1993-01-12) * column 4, line 8 - line 48 * * column 7, line 23 - line 31 * * column 8, line 25 - line 35; figure 1A * -----	2,7,8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-3,6,9-38

Sequence of process steps for pre-treatment of a substrate prior to electroless plating.

2. Claims: 2,4,5

Composition of an electroless plating solution.

3. Claims: 2,7,8

Method of cleaning a substrate surface from organic material.



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INCOMPLETE SEARCH
SHEET C

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Claim(s) searched completely:
1,6,11-17,22,28-31,33,38

Claim(s) searched incompletely:
2,3,34,35

Claim(s) not searched:
9,10,18-21,23-27,32,36,37

Reason for the limitation of the search:

Claim 2 and the depending claim 3 were searched partially since claim 2 contains features of invention 2 (oxidation of the surface to remove organic material) and of invention 3 (composition of the electroless plating liquid). The features of inventions 2 and 3 were not searched.

Claim 34 and the depending claim 35 are unclear since claim 33 refers to a "hole", whereas no hole is mentioned in claim 33, on which both claims depend. They were searched in accordance with the independent claim 33.

Claims not searched:

Claim 9 and the depending claim 10 are unclear since no barrier layer is mentioned in claim 1.

Claims 18,19,20,21,23,24,25,26,27,32 are unclear since an apparatus is claimed but the features in the claims concern a method, a plating composition, or structural features of the object to be plated.

Claims 36 and 37 are unclear is unclear since a structure is claimed but the features in the claims concern a plating composition.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 00 40 0172

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-09-2000

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0506993	A	07-10-1992	US 5077085 A	31-12-1991
			US 5389496 A	14-02-1995
			US 5079600 A	07-01-1992
			US 5510628 A	23-04-1996
			US 5721131 A	24-02-1998
			US 5500315 A	19-03-1996
			US 5324591 A	28-06-1994
US 5696207	A	09-12-1997	US 5945486 A	31-08-1999
WO 9746326	A	11-12-1997	AU 3221197 A	05-01-1998
			EP 0843597 A	27-05-1998
			US 5925415 A	20-07-1999
WO 9722733	A	26-06-1997	DE 69608669 D	06-07-2000
			EP 0811083 A	10-12-1997
WO 8401392	A	12-04-1984	AT 42972 T	15-05-1989
			CA 1219179 A	17-03-1987
			DE 3379843 D	15-06-1989
			DK 252184 A	23-05-1984
			EP 0120083 A	03-10-1984
			HK 26090 A	12-04-1990
			IN 161672 A	16-01-1988
			IT 1169845 B	03-06-1987
			NO 841930 A	15-05-1984
			SG 2190 G	13-07-1990
			US 4622917 A	18-11-1986
			US 4734296 A	29-03-1988
WO 9722419	A	26-06-1997	AU 1150397 A	14-07-1997
			CA 2238490 A	26-06-1997
			EP 0866735 A	30-09-1998
US 3011920	A	05-12-1961	DE 1197720 B	
JP 58190025	A	05-11-1983	NONE	
JP 04074870	A	10-03-1992	JP 2026790 C	26-02-1996
			JP 7053909 B	07-06-1995
US 5674787	A	07-10-1997	NONE	
JP 62287081	A	12-12-1987	NONE	
US 4169171	A	25-09-1979	US 4160049 A	03-07-1979

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-09-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4169171 A		CA 1136006 A	23-11-1982
US 5837662 A	17-11-1998	WO 9931724 A	24-06-1999
US 5178682 A	12-01-1993	JP 1319944 A	26-12-1989
		US 5028560 A	02-07-1991